

CLAIM AMENDMENTS

1 1. (Currently amended) A method of determining a placement of services of a
2 distributed application onto nodes of a distributed resource infrastructure
3 comprising the steps of:
4 a. establishing a placement indicator for a specific service;
5 b. forming communication constraints between node pairs which ensure that
6 a sum of transport demands between a particular node pair does not exceed a
7 transport capacity between the particular node pair, each term of the sum
8 comprising a product of a first placement variable, a second placement
9 variable, and the transport demand between the services associated with the
10 first and second placement variables;
11 e. forming an objective; and
12 d. employing a local search solution to solve an integer program comprising
13 the placement indicator, the communication constraints, and the objective to
14 determine the placement of the services onto the nodes.

1 2. (Original) The method of claim 1 wherein the placement indicator
2 comprises a pre-defined placement.

1 3. (Original) The method of claim 2 wherein the pre-defined placement
2 comprises placing the specific service onto a specific node.

1 4. (Original) The method of claim 2 wherein the pre-defined placement
2 comprises not placing the specific service onto a specific node.

1 5. (Original) The method of claim 1 wherein the placement indicator
2 comprises a neutral indication of whether the specific service is to be placed onto
3 a specific node.

1 6. (Currently amended) A method of determining a placement of services of a
2 distributed application onto nodes of a distributed resource infrastructure
3 comprising the steps of:
4 a. establishing an application model of the services comprising transport

5 demands between the services;

6 b. establishing an infrastructure model of the nodes comprising transport

7 capacities between the nodes;

8 e. establishing a placement model comprising placement indicators for the

9 services;

10 d. forming an integer program that comprises:

11 i. a set of placement variables for a combination of the services and the

12 nodes, each of the placement variables indicating whether a particular

13 service is located on a particular node;

14 ii. communication constraints between node pairs which ensure that a

15 sum of the transport demands between a particular node pair does not

16 exceed the transport capacity between the particular node pair, each term

17 of the sum comprising a product of a first placement variable, a second

18 placement variable, and the transport demand between the services

19 associated with the first and second placement variables;

20 iii. placement constraints for the services which ensure that the services

21 are placed onto the nodes in accord with the placement indicators; and

22 iv. an objective; and

23 e. employing a local search solution to solve the integer program which

24 determines the placement of the services onto the nodes.

1 7. (Original) The method of claim 6 wherein a particular placement indicator

2 comprises an indication that a specific service is to be placed onto a specific node.

1 8. (Original) The method of claim 6 wherein a particular placement indicator

2 comprises an indication that a specific service is not to be placed onto a specific

3 node.

1 9. (Original) The method of claim 6 wherein a particular placement indicator

2 comprises a neutral indication of whether a specific service is to be placed onto a

3 specific node.

1 10. (Original) The method of claim 9 wherein a default for the placement

2 indicators comprises the neutral indication.

1 11. (Currently amended) A method of determining a placement of services of a
2 distributed application onto nodes of a distributed resource infrastructure
3 comprising the steps of:
4 a. establishing an application model of the services that comprises processing
5 demands for the services, storage demands for the services, and transport
6 demands between the services;
7 b. establishing an infrastructure model of the nodes that comprises processing
8 capacities for the nodes, storage capacities for the nodes, and transport
9 capacities between the nodes;
10 c. establishing a placement model comprising placement indicators for the
11 services;
12 d. forming an integer program that comprises:
13 i. a set of placement variables for a combination of the services and the
14 nodes, each of the placement variables indicating whether a particular
15 service is located on a particular node;
16 ii. processing constraints which ensure that a sum of the processing
17 demands for each of the nodes does not exceed the processing capacity for
18 the node;
19 iii. storage constraints which ensure that a sum of the storage demands for
20 each of the nodes does not exceed the storage capacity for the node;
21 iv. first placement constraints which ensure that each of the services is
22 placed on one and only one node;
23 v. second placement constraints which ensure that the services are placed
24 onto the nodes in accord with the placement indicators;
25 vi. communication constraints between node pairs which ensure that a
26 sum of the transport demands between a particular node pair does not
27 exceed the transport capacity between the particular node pair, each term
28 of the sum comprising a product of a first placement variable, a second
29 placement variable, and the transport demand between the services
30 associated with the first and second placement variables; and
31 vii. an objective of minimizing communication traffic between the nodes
32 and balancing processing loads on the nodes; and
33 e. employing a local search solution to solve the integer program which

34 determines the placement of the services onto the nodes.

1 12. (Currently amended) A computer readable memory comprising computer
2 code for directing a computer to make a determination of a placement of services
3 of a distributed application onto nodes of a distributed resource infrastructure, the
4 determination of the placement of the services onto the nodes comprising the steps
5 of:
6 a. establishing a placement indicator for a specific service;
7 b. forming communication constraints between node pairs which ensure that
8 a sum of transport demands between a particular node pair does not exceed a
9 transport capacity between the particular node pair, each term of the sum
10 comprising a product of a first placement variable, a second placement
11 variable, and the transport demand between the services associated with the
12 first and second placement variables;
13 e. forming an objective; and
14 d. employing a local search solution to solve an integer program comprising
15 the placement indicator, the communication constraints, and the objective to
16 determine the placement of the services onto the nodes.

1 13. (Original) The computer readable memory of claim 12 wherein the
2 placement indicator comprises a pre-defined placement.

1 14. (Original) The computer readable memory of claim 13 wherein the pre-
2 defined placement comprises placing the specific service onto a specific node.

1 15. (Original) The computer readable memory of claim 13 wherein the pre-
2 defined placement comprises not placing the specific service onto a specific node.

1 16. (Original) The computer readable memory of claim 12 wherein the
2 placement indicator comprises a neutral indication of whether the specific service
3 is to be placed onto a specific node.

1 17. (Currently amended) A computer readable memory comprising computer
2 code for directing a computer to make a determination of a placement of services

3 of a distributed application onto nodes of a distributed resource infrastructure, the
4 determination of the placement of the services onto the nodes comprising the steps
5 of:
6 a. establishing an application model of the services comprising transport
7 demands between the services;
8 b. establishing an infrastructure model of the nodes comprising transport
9 capacities between the nodes;
10 c. establishing a placement model comprising placement indicators for the
11 services;
12 d. forming an integer program that comprises:
13 i. a set of placement variables for a combination of the services and the
14 nodes, each of the placement variables indicating whether a particular
15 service is located on a particular node;
16 ii. communication constraints between node pairs which ensure that a
17 sum of the transport demands between a particular node pair does not
18 exceed the transport capacity between the particular node pair, each term
19 of the sum comprising a product of a first placement variable, a second
20 placement variable, and the transport demand between the services
21 associated with the first and second placement variables;
22 iii. placement constraints for the services which ensure that the services
23 are placed onto the nodes in accord with the placement indicators; and
24 iv. an objective; and
25 e. employing a local search solution to solve the integer program which
26 determines the placement of the services onto the nodes.

1 18. (Original) The computer readable memory of claim 17 wherein a
2 particular placement indicator comprises an indication that a specific service is to
3 be placed onto a specific node.

1 19. (Original) The computer readable memory of claim 17 wherein a
2 particular placement indicator comprises an indication that a specific service is not
3 to be placed onto a specific node.

1 20. (Original) The computer readable memory of claim 17 wherein a

2 particular placement indicator comprises a neutral indication of whether a specific
3 service is to be placed onto a specific node.

1 21. (Original) The computer readable memory of claim 20 wherein a default
2 for the placement indicators comprises the neutral indication.

1 22. (Original) The computer readable memory of claim 20 wherein a matrix is
2 specified which expresses constraints or preferences for identifying a placement of
3 services onto nodes.

1 23. (Currently amended) A computer readable memory comprising computer
2 code for directing a computer to make a determination of a placement of services of a
3 distributed application onto nodes of a distributed resource infrastructure, the
4 determination of the placement of the services onto the nodes comprising the steps of:
5 a. establishing an application model of the services that comprises processing
6 demands for the services, storage demands for the services, and transport
7 demands between the services;
8 b. establishing an infrastructure model of the nodes that comprises processing
9 capacities for the nodes, storage capacities for the nodes, and transport
10 capacities between the nodes;
11 c. establishing a placement model comprising placement indicators for the
12 services;
13 d. forming an integer program that comprises:
14 i. a set of placement variables for a combination of the services and the
15 nodes, each of the placement variables indicating whether a particular
16 service is located on a particular node;
17 ii. processing constraints which ensure that a sum of the processing
18 demands for each of the nodes does not exceed the processing capacity for
19 the node;
20 iii. storage constraints which ensure that a sum of the storage demands for
21 each of the nodes does not exceed the storage capacity for the node;
22 iv. first placement constraints which ensure that each of the services is
23 placed on one and only one node;
24 v. second placement constraints which ensure that the services are placed

